Imaging small-scale convection and structure of the mantle in the south Pacific: A US Contribution to an international *PacificArray*

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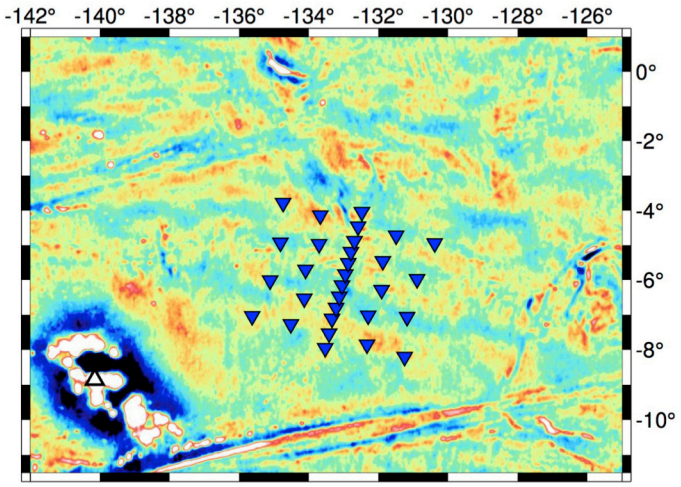
With a relatively simple crustal structure and fairly short geological history, ocean basins provide an unblemished view into the mantle processes, including convective mantle flow that controls deformation and evolution of Earth's surface. Observations are limited, however, due to the difficulty in obtaining seafloor seismic and other data critical for imaging the mantle. As part of the grassroots international collaboration PacificArray, we will deploy two 30-station arrays of broadband ocean-bottom seismographs (OBS) in the south Pacific. These arrays are designed to address specific critical questions on the dynamics of the oceanic asthenosphere, including its underlying state (presence of melt, water or other volatiles, and deformation mechanism) and the importance of so-called secondary or small-scale convection, while also providing fundamentally new and unique sampling of the upper and deep mantle for global tomography. Dubbed Pacific ORCA (OBS Research on Convecting Asthenosphere), the experiment targets regions where 200-300-km wavelength lineations in the gravity field have been interpreted as evidence of small-scale convection in the asthenosphere. The first array (Young ORCA) was deployed in April 2018 on 30 Ma seafloor northeast of the Marquesas Islands. It consists of a dense linear subarray with ~35-45 km spacing designed for body-wave tomographic imaging of the asthenosphere, embedded within a 450x500 km two-dimensional array with ~120-150 km spacing designed for anisotropic surface-wave imaging of the lithosphere-asthenosphere system. During the deployment cruise we collected high-resolution multibeam bathymetry, which shows clear systematic variations in abyssal-hill fault orientations within the experiment region. We also developed an improved procedure for estimating seafloor instrument location with a higher degree of precision and accuracy. Young ORCA will be recovered in spring/summer 2019, and will be followed by deployment of Old ORCA on 120 Ma seafloor in the far southwestern Pacific. Collaborative efforts by Japan, Korea, and/or Taiwan are planned for late 2018 or 2019 in the northwest Pacific.



Young ORCA OBS deployment (blue triangles), approximately 400 km northeast of the Marquesas Islands (GSN station is white triangle). Color background shows filtered satellite gravity field (Sandwell et al., 2015). NW-SE lineations originally noted by Haxby and Weissel (1986) are clear. They trend parallel to apparent plate motion in a hotspot reference frame. Sharp SW-NE features are fracture zones that approximately correspond to the fossil spreading direction.